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Non-SCE3.1: Disabling adaptive predictor compensation for 8x8 bi-prediction

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Overall Summary

- An adaptive predictor compensation (APC) is proposed in SCE3.1 to allow using reconstructed base layer (BL) samples to refine enhancement layer (EL) sample predictors
  - Only applied to inter 2Nx2N CU with at least one non-zero residue
  - $Pred_{EL}' = (Pred_{EL} + Rec_{BL}) >> 1$
  - **In this proposal, we disable APC for 8x8 bi-prediction CU.**

- 0.4-2.4% BD-rate savings

- 4% encoding time increase, no decoding time increase

- **No increase in the worst case memory bandwidth**

	RA-2x	RA-1.5x	RA-SNR	LP-2x	LP-1.5x	LP-SNR	LB-2x	LB-1.5x	LB-SNR	Enc. T	Dec. T
APC	-0.3%	-0.4%	-0.6%	-1.4%	-1.4%	-2.4%	-0.5%	-0.3%	-0.7%	104%	100%

	Multipliers	Adders	Memory Bandwidth	# of Ref. Frames	Tables Size
Avg. case	99%	100%	103%		
Worst case	112%	112%	100%	100%	100%

Adaptive Predictor Compensation (APC)

- The BL reconstructed picture may predict the current EL picture better than the EL reference picture for regions that newly appear or have light changes

- Therefore, the BL reconstructed texture can be used to refine the EL motion compensated predictors

- SCE 3.1:
  - Apply the APC to inter 2Nx2N CU that has at least one non-zero residue
  - Signal an APC_enable_flag to enable or disable the refinement

- Additional restriction to reduce the worst case bandwidth
  - **Disabling APC for 8x8 bi-prediction CU**

- $Pred_{EL}' = (Pred_{EL} + Rec_{BL} + 1) >> 1$

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Simulation Results

- Anchor: SHM-1.0 IntraBL mode

- Provides 0.3-2.4% BD-rate savings
  - Compared with the original APC in SCE3.1, the average BD-rate increase is less than 0.1%

- The encoding time is roughly increased by 4%, and the decoding time is roughly unchanged.

- Thank Samsung for cross-verification (JCTVC-M0252)

	RA-2x	RA-1.5x	RA-SNR	LP-2x	LP-1.5x	LP-SNR	LB-2x	LB-1.5x	LB-SNR	Enc. T	Dec. T
SCE 3.1	-0.4%	-0.5%	-0.7%	-1.4%	-1.4%	-2.4%	-0.6%	-0.4%	-0.9%	104%	100%
Proposed	-0.3%	-0.4%	-0.6%	-1.4%	-1.4%	-2.4%	-0.5%	-0.3%	-0.7%	104%	100%

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Bandwidth and Complexity Analysis

- Experiments were conducted according to the methodology defined in JCTVC-L0440

- No worst case bandwidth increase

	Average Computations		Average Memory Bandwidth		
	Multipliers	Adders	8b/8b	64b/256b	64b/512b
Proposed	99%	100%	104%	103%	103%

	Worst Case Computations		Worst Case Memory Bandwidth		Memory Usage	
	Multipliers	Adders	MemBW (2D:4x2)	MemBW (2D:8x2)	# of Ref. Frames	Tables Size
Proposed	112%	112%	100%	100%	100%	100%

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Conclusions

- In the proposed adaptive predictor compensation (APC), the reconstructed BL samples can be used to refine the EL sample predictors.
    - Only applied to inter 2Nx2N CU with at least one non-zero residue, and is **disabled for 8x8 bi-prediction CU**
    - PredEL' = (PredEL + RecBL) >> 1

- Simulation results
    - 0.4-2.4% BD-rate savings
    - The encoding time is roughly increased by 4%, and the decoding time is roughly unchanged.
    - The average case bandwidth increase is 3%, and the average computations are roughly unchanged.
    - **No worst case bandwidth increase**
    - The worst case computation increase is 12%.

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BD-rates and Runtimes

	RA HEVC 2x			RA HEVC 1.5x			RA HEVC SNR		
	Y	U	V	Y	U	V	Y	U	V
Class A	-0.3%	-1.6%	-1.7%				-0.3%	-1.6%	-1.9%
Class B	-0.3%	-2.0%	-2.4%	-0.4%	-2.3%	-2.6%	-0.8%	-4.3%	-5.2%
Overall (Test vs Ref)	-0.3%	-1.9%	-2.2%	-0.4%	-2.3%	-2.6%	-0.6%	-3.6%	-4.2%
Overall (Test vs single layer)	18.9%	29.4%	30.0%	16.0%	25.3%	27.2%	14.1%	23.7%	26.4%
EL only (Test vs Ref)	-0.4%	-2.0%	-2.4%	-0.5%	-2.6%	-3.0%	-0.8%	-3.9%	-4.7%
Enc Time[%]	104.9%			103.8%			103.8%		
Dec Time[%]	100.8%			100.1%			100.3%		
Enc Mem[%]	#DIV/0!			#DIV/0!			#DIV/0!		
BL Match	Matched			Matched			Matched		

	LD-P HEVC 2x			LD-P HEVC 1.5x			LD-P HEVC SNR		
	Y	U	V	Y	U	V	Y	U	V
Class A	-1.3%	-3.3%	-3.6%				-1.6%	-4.1%	-4.7%
Class B	-1.5%	-2.8%	-3.5%	-1.4%	-4.5%	-5.2%	-2.7%	-7.7%	-9.1%
Overall (Test vs Ref)	-1.4%	-3.0%	-3.5%	-1.4%	-4.5%	-5.2%	-2.4%	-6.7%	-7.9%
Overall (Test vs single layer)	24.3%	32.3%	33.2%	20.8%	26.7%	28.5%	19.5%	24.7%	27.0%
EL only (Test vs Ref)	-1.8%	-3.4%	-4.0%	-1.9%	-5.3%	-6.1%	-3.0%	-7.5%	-8.8%
Enc Time[%]	105.4%			103.8%			103.9%		
Dec Time[%]	100.3%			99.8%			99.7%		
Enc Mem[%]	#DIV/0!			#DIV/0!			#DIV/0!		
BL Match	Matched			Matched			Matched		

Optional Tests

	LD-B HEVC 2x			LD-B HEVC 1.5x			LD-B HEVC SNR		
	Y	U	V	Y	U	V	Y	U	V
Class A	-0.4%	-2.0%	-2.2%				-0.5%	-2.3%	-2.6%
Class B	-0.6%	-2.0%	-2.4%	-0.3%	-2.9%	-3.0%	-0.8%	-4.6%	-5.6%
Overall (Test vs Ref)	-0.5%	-2.0%	-2.4%	-0.3%	-2.9%	-3.0%	-0.7%	-4.0%	-4.8%
Overall (Test vs single layer)	27.6%	34.5%	35.3%	24.2%	28.9%	30.9%	22.9%	27.8%	30.0%
EL only (Test vs Ref)	-0.7%	-2.2%	-2.6%	-0.5%	-3.2%	-3.4%	-1.0%	-4.4%	-5.2%
Enc Time[%]	104.4%			103.1%			103.4%		
Dec Time[%]	100.6%			99.3%			100.6%		
Enc Mem[%]	#DIV/0!			#DIV/0!			#DIV/0!		
BL Match	Matched			Matched			Matched		

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Average Bandwidths & Computations

	RA HEVC 2x					RA HEVC 1.5x					RA HEVC SNR				
	8b/8b	64b/256b	64b/512b	Mults	Adds	8b/8b	64b/256b	64b/512b	Mults	Adds	8b/8b	64b/256b	64b/512b	Mults	Adds
Class A	101%	101%	101%	100%	100%						102%	101%	101%	99%	99%
Class B	102%	101%	101%	99%	100%	102%	101%	101%	99%	100%	104%	102%	102%	98%	99%
Overall	**101%**	**101%**	**101%**	**99%**	**100%**	**102%**	**101%**	**101%**	**99%**	**100%**	**103%**	**102%**	**102%**	**98%**	**99%**

	LD-P HEVC 2x					LD-P HEVC 1.5x					LD-P HEVC SNR				
	8b/8b	64b/256b	64b/512b	Mults	Adds	8b/8b	64b/256b	64b/512b	Mults	Adds	8b/8b	64b/256b	64b/512b	Mults	Adds
Class A	105%	104%	104%	100%	102%						108%	107%	107%	98%	99%
Class B	105%	104%	104%	100%	102%	105%	104%	104%	100%	101%	110%	107%	108%	97%	98%
Overall	**105%**	**104%**	**104%**	**100%**	**102%**	**105%**	**104%**	**104%**	**100%**	**101%**	**110%**	**107%**	**108%**	**97%**	**99%**

	LD B HEVC 2x					LD-B HEVC 1.5x					LD-B HEVC SNR				
	8b/8b	64b/256b	64b/512b	Mults	Adds	8b/8b	64b/256b	64b/512b	Mults	Adds	8b/8b	64b/256b	64b/512b	Mults	Adds
Class A	102%	101%	101%	99%	100%						104%	102%	103%	98%	99%
Class B	102%	102%	102%	99%	100%	102%	101%	101%	99%	100%	105%	103%	103%	96%	97%
Overall	**102%**	**101%**	**101%**	**99%**	**100%**	**102%**	**101%**	**101%**	**99%**	**100%**	**105%**	**103%**	**103%**	**97%**	**98%**

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